

THE DISTRIBUTION OF THE CORAL,
CARYOPHYLLIA SMITHII AND THE BARNACLE
PYRGOMA ANGLICUM IN BRITISH WATERS

BY

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SYNOPSIS

Caryophyllia smithii is demonstrated to have an extensive distribution in British waters from Portland and the Channel Islands westwards, all around Ireland to the Shetlands. In continental Europe, it is found on the south-west coasts of Norway and on the Bohuslan coast of Sweden. Southwards it reappears in the Channel Islands, extending to the Mediterranean and Madeira. Rossi's belief that the species is cosmopolitan requires further consideration in view of her suggestion that *C. alaskensis* from the North Pacific is the same species.

Pyrgoma anglicum is shown to be restricted to the Western Channel (reaching Exmouth in E. Devon and Roscoff on the Finisterre coast) and the western approaches reaching Pembroke-shire. Its presence on the coral in the Channel Islands has not yet been reported. This species is thought to occur on about one in six *Caryophyllia* in British waters and individual corals may carry from one to twenty-four barnacles. These display some gregariousness in settlement, preferring their own shells to that of the coral for settlement. The species also occurs on *Leptopsammia*, *Dendrophyllia*, *Paracyathus*, *Astroides*, *Psammodora*, *Cladocora*, *Balanophyllia* and *Schizoculina*. On the last three genera it is here recorded for the first time.

I. INTRODUCTION

THE Devonshire cup-coral, *Caryophyllia smithii*, is, to quote a general belief voiced by Le Danois (1957 : 83) "very common on the continental shelf south of Ireland, and is very occasionally found at low water in south-west England". However,

as will be shown in this paper, the species has a much wider distribution extending northwards on our western coasts to the Shetlands and to the coasts of Norway and Sweden, and southwards at least to the Mediterranean.

On the south coasts of Devon and Cornwall *Caryophyllia* is sometimes found with a commensal barnacle *Pyrgoma anglicum* which lives firmly cemented either to the lip or to the column of the coral. However, its exact distribution in relation to that of *Caryophyllia* needed elucidation, and in this connexion, a remark by Hiro (1936 : 46) that of the cirripedes associated with corals, *Creusia* and *Pyrgoma* "are known to live almost exclusively in tropical waters" seemed significant. It suggested that *Pyrgoma anglicum* might be a warm-water species (like the *Octopus* and many other creatures) which is just able to maintain itself on the western parts of our coasts at the limit of its northward distribution.

Examination of the evidence strongly supports this suggestion.

2. THE DISTRIBUTION OF *CARYOPHYLLIA SMITHII* STOKES & BRODERIP

In the following account I have drawn largely on fauna lists and on the collections of the British Museum which contain much early material associated with Cranch, Leach, Gosse and Norman. Unfortunately, however, much of this early material is lacking in precise details of locality.

(a) *The Status of Caryophyllia smithii*

The following appear to be the principal synonyms of the species :

Caryophyllia cyathus, Fleming, 1828. *Hist. Brit. Animals* : 508 (non Ellis).

Turbinolia borealis Fleming, 1828. *Ibid.* : 509.

Caryophyllia sessilis Bellamy, 1839. *S. Devon Nat. Hist.* : 330, pl. 18.

Caryophyllia smithii Stokes & Broderip, 1828. *Zool. J.* : 486.

Johnston, 1838. *Brit. Zooph.* : 207, fig. 30.

Couch, 1844. *Cornish Fauna*, 3 : 72, pl. 12, fig. 3.

Gosse, 1853. *Devonshire Coast* : 108, pl. 5, figs. 1-5.

Johnston, 1847. *Brit. Zooph.* Ed. 2 : 198, pl. 35, figs. 4-8.

Goose, 1860. *Actinologia Britannica* : 310, pl. X, figs. 12-13.

?Norman, 1868. *Rep. Brit. Assoc. Norwich* : 319.

Caryophyllia smithii var. *castanea* Gosse, 1860. *Actinologia Britannica* : 312.

Caryophyllia smithii var. *esmeralda* Gosse, 1860. *Ibid.* : 312.

Caryophyllia smithii var. *clara* Gosse, 1860. *Ibid.* : 312.

Caryophyllia clavus var. *borealis*, Duncan, 1874. *Trans. zool. Soc. Lond.*, 8 : 312, pl. 48, fig. 6.

Caryophyllia clavus var. *smithii*, Duncan, 1874. *Ibid.* 8 : 312, pl. 48, figs. 11-12.

Caryophyllia clavus var. *epitheca* Duncan, 1878. *Ibid.* 8 : 312, pl. 48, figs. 13-16.

Paracyathus inornatus Duncan, 1878. *Ibid.* 10 : 241, pl. 44, figs. 14-16.

Coenocyathus dohrni Doderlein. *Mitth. zool. Sta. Neapel*, 21 : 121, pl. 7, figs.

?*Caryophyllia alaskensis* Vaughan, 1941. *J. Palaeont.* **15**: 180, figs. 1-4.
 Durham & Barnard, 1952. *Hancock Pacific Exped.* **16**: 81, pl. 9, fig. 41a + b.
Caryophyllia smithii var. *meridionalis* Picard, 1952. *Bull. Lab. Marit. Dinard*,
36: 6.

There has been some confusion of this species with the Mediterranean species *Caryophyllia clavus* Scacchi notably by Joubin (1928) and Duncan (1874), these errors in identification having been pointed out by Picard (1952) and Rossi (1957). The latter recognizes three distinct species in the Mediterranean, viz., *C. smithii* Stokes & Broderip, *C. clavus* Scacchi and *C. cyathus* Ellis & Solander. She has also examined the type specimens of *Paracyathus inornatus* Duncan, 1878, and *Coenocyathus dohrni* Doderlein, 1913, and concludes that they are identical with *C. smithii*. Picard (1952), who has examined *C. smithii* both from Dinard and the Mediterranean, distinguishes the Mediterranean form as a new variety, because "les calices de la *Caryophyllia* méditerranéenne sont, dans l'ensemble, plus petits et les septes laissent un espace central moins prononcé, cette dernière particularité entraînant une réduction de la prolifération des rubans tordus de la columella chez ces *C. smithii* méditerranéens que je propose de distinguer comme forme *meridionalis*". Duncan (1874: 312) who placed *C. smithii* in *C. clavus* as var. *smithii* states "It has a broad base; but this is the only strong distinction between it and *Caryophyllia clavus*. The gradation of a delicate pedunculated *Caryophyllia clavus* into a broad-based form with all the other peculiarities, depends upon the depth of water and the nature of the bottom; and the variety *borealis* gradually becomes variety *smithii*, both in the northern seas and in the Mediterranean." Rossi (1957) however, draws distinctions between the two forms. Whether these and the colour differences that have been reported in the living animals are specific or merely ecophenotypic remains to be elucidated. Accordingly I have omitted those records in which there is some doubt about identity, but I have included Norman's records from the Shetlands (Pl. 1, fig. 4) with some reservations, especially as Dr. Rossi (*in litt.*) regards these specimens as *C. clavus*.

Although not stated by Stokes & Broderip (1828) it appears that the type locality of *C. smithii* is the same as noted by de la Beche (1828) in the same paper, that is, "Corbons rocks at the end of Torbay sands".

(b) *Distribution in the Channel*

Caryophyllia smithii has been recorded from numerous localities in the Western Channel and the distribution as noted in Text-fig. 1 is based on published records and material in the British Museum (Natural History). The latter contains, as noted earlier, much historical material and this has been supplemented with more recent collecting. The old record from the Scilly Isles (North, 1850) has been confirmed from material dredged off Tresco by Mr. W. Fowler (BM. No. 1960.8.4.1).

Canon A. M. Norman's collection contains a fine series with the associated *Pyrgoma* from off Dodman Point, Cornwall. The coral has been frequently recorded in the Plymouth area by the Marine Biological Association (1957 and earlier fauna lists) and notably by Allen (1899) and Forster (1958). Records from deeper water in

this area are given by Crawshaw (1912) and his positions are plotted in Text-fig. 3. East of Salcombe, there are many records from the Torquay area; these are detailed below. There is also a record from Exmouth in the Gwyn Jeffreys collection in the U.S. National Museum.

It is now possible to add a new record from Portland and others from the central area of the Channel (from the Manihine collections) thus extending the known range eastwards.

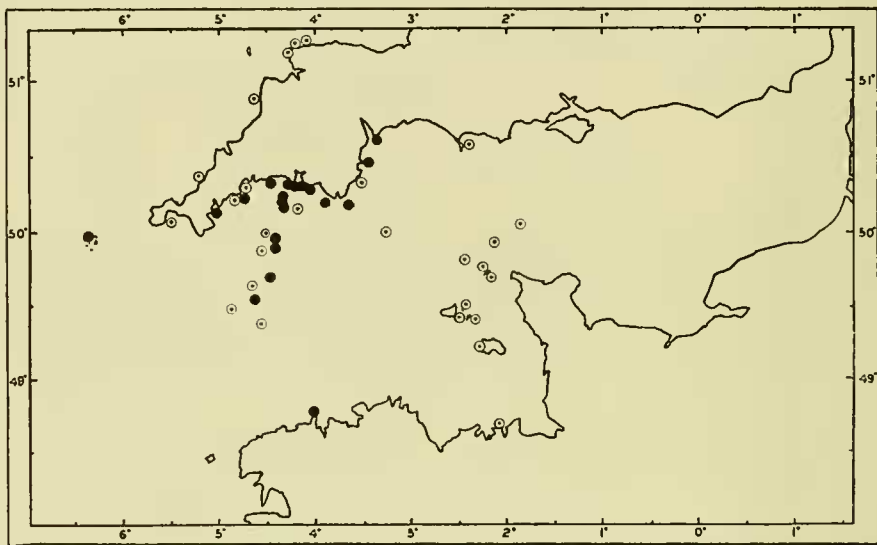


FIG. 1. The known distribution of *Caryophyllia smithii* in the English Channel and the north coasts of Cornwall and Devon; filled (black) circles denote *Caryophyllia* with *Pyrgoma*, and open circles, *Caryophyllia* without *Pyrgoma*. The Pembrokeshire records of *Pyrgoma* complete the known distribution of this species in British waters.

Caryophyllia is also known to occur at all of the Channel Islands (Ansted & Latham, 1862; Sharp, 1909; Sinel, 1906) and on the north coast of France it has been recorded from several localities at Roscoff and several times from one point near Dinard.

There are no records known to me from the eastern half of the Channel. For the English coast, local fauna lists for Bournemouth (Waddington, 1914) and the Isle of Wight (Morey, 1909) contain no records but it is to be expected that aqualung divers will find this species for some distance further east wherever there are suitable substrata offshore.

Channel records of *Caryophyllia smithii*

Scilly Isles: (North, 1850:180; Hickson, 1909:398); off Tresco, new record (see p. 405).

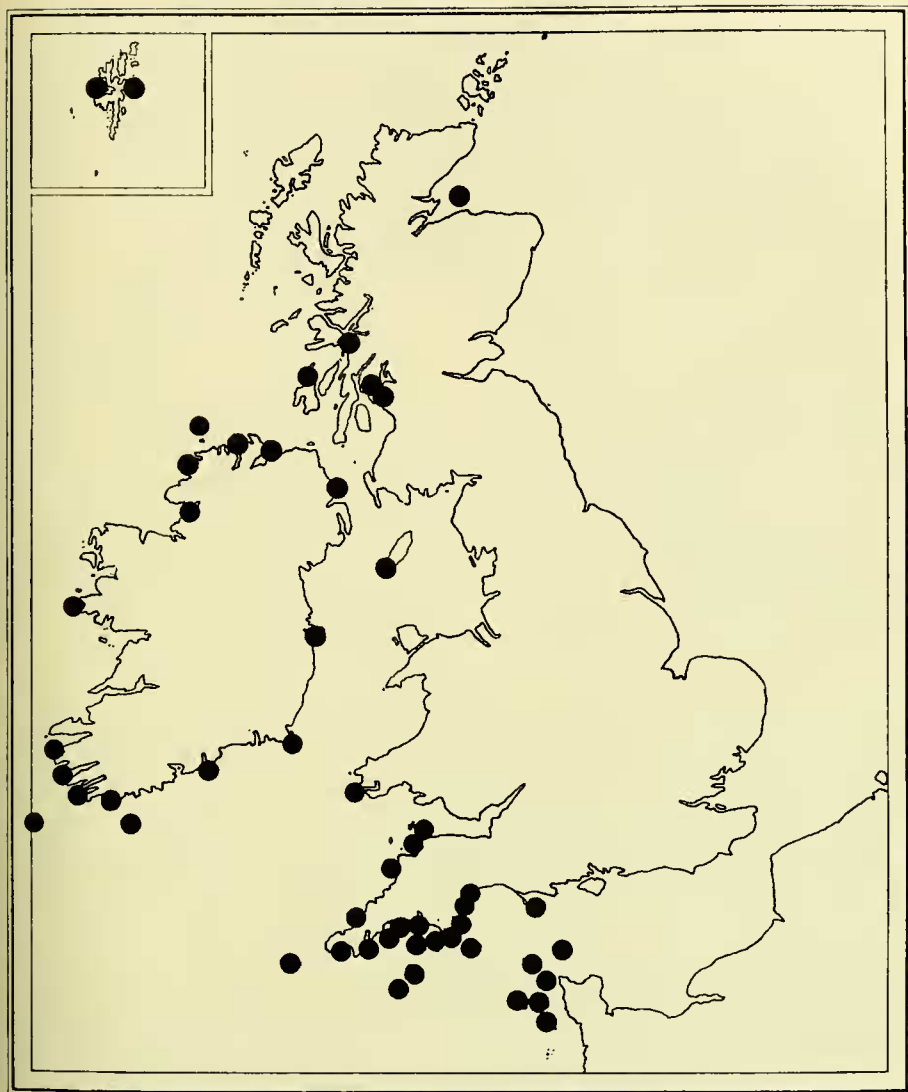


FIG. 2. The recorded distribution of *Caryophyllia smithii* around the British Isles. Western Channel records are more fully represented in Figs. 1 and 3.

South coasts of Cornwall and Devon : Mount's Bay, Penzance (Courtney, 1845 : 43) ; Falmouth, W. P. Cocks (see Norman & Scott, 1906 : 225) ; Veryan Bay (Couch, 1844 : 72, pl. 12, fig. 3) ; Dodman Point, Coll. A. M. Norman (B.M. No. 1905.11.1.7-15) ; Mevagissey (Couch, 1844 : 72) ; Polperro (Couch, 1844 : 72 ; Norman & Scott, 1906 : 225).

Plymouth Sound : various localities, Eddystone area (Allen, 1899) ; Breakwater, Mewstone ledge, SW. of Eddystone, Hand Deep etc. (*Plymouth Marine Fauna*, Ed. 3, p. 68) : Queener Pt., Whitsand Bay ; 4-7 m., Penlee Pt. ; Eddystone ; Hand Deep (Forster, 1958 : 474 *et seq.*).



FIG. 3. Stations in the outer Western Channel at which Crawshay (1912) recorded *Caryophyllia* with *Pyrgoma* (filled circles) and *Caryophyllia* only (open circles).

Stoke Point area : N.E. of Stoke Point (Forster, 1958 : 474).

Bolt Head shell gravel (Allen, 1899 : 437).

Prawle stony ground (Allen, 1899 : 439).

Dartmouth (Parfitt, 1866 : 19).

Torquay : Corbons, end of Torbay sands (de la Beche, also Stokes & Broderip, 1828) ; Johnston (1837 : 208), Jones (1858 : 141) ; Templer (1855) ; Parfitt (1866 : 19) ; Anstey's Cove, 28th March, 1961 (Brit. Sub-Aqua Club).

Exmouth : Jeffreys Collection, Smithsonian Institution (Pilsbry, 1916 : 262).

Coast of Dorset :

Portland : Off breakwater, 1st August, 1959, 35-70 ft. Coll. T. Ingram (B.M. 1959.8.5.1-14).

Outer Western Channel :

Various stations extending from the Eddystone to mid-channel (Crawshay, 1912). These records are plotted on Text-fig. 3.

Central Channel Area :

New records from the following Manihine stations :

Manihine St. 9, 50° 03' 30" N., 01° 51' W., 25th July, 1947, 60 m., rocky bottom, 1 specimen, trawled.

Manihine St. 47, 49° 55' 20" N., 02° 8' W., 60 fms., stony bottom, dredge, 1 specimen.

Manihine St. 50, 49° 49' N., 02° 28' 45" W., 31st August, 1948, 70 fms., stony bottom, 2 specimens.

Manihine St. 53, 50° 0' N., 03° 16' W., 28.5 fms., dredge, gravel bottom, 4 specimens.

Channel Islands :

Alderney : Sharp (1909 : 93).

Guernsey : Collings (1863 : 173) ; Ansted & Latham (1862 : 240) ; Koehler (1885 : 56) ; Mabbs (1906) ; Tanner (1908 : 283) ; Sharp (1908 : 479 and 481).

Sark : Collings (1863 : 173) ; Ansted & Latham (1862 : 240).

Herm : Ansted & Latham (1862 : 240) ; Koehler (1885 : 56).

Jersey : Sinel (1906 : 31).

North coast of France :

Roscoff : Lacaze-Duthiers (1897 : 73, pl. 4, fig. E) ; Teissier (1950 : 39).

Dinard : Point de Briantais (de Beauchamp, 1929 : 32 ; Lami, 1939 : 33, pl. 1 ; Picard, 1952 : 5).

(c) *Distribution elsewhere in the British Isles*

On the north coasts of Cornwall and Devon, the Ilfracombe district is one of the classical localities for *Caryophyllia* where it has been often reported, and some of P. H. Gosse's material is in the British Museum (B.M. No. 1852.12.9.24-32 and 1853.28.10.10-20). In this area it has been found at extreme low water from Combe Martin to Watermouth (Palmer, 1946). Records from the North Cornish coasts are few, as might be expected, but the *Victoria County History of Cornwall* mentions Newquay and Bude (Clarke, 1906).

Northwards there are no records that I can find for the Bristol Channel north of the Ilfracombe area (Bassindale, 1941) and Fowell (1947) does not record the species from the Gower Peninsular. Pembrokehire records (see below) are summarized by Bassindale & Barrett (1957), while Chadwick's 1903 record from the Isle of Man has recently been supplemented by new records kindly supplied by Dr. N. S. Jones (personal communication).

Caryophyllia occurs all round the Irish coast. Haddon's early records (1886) from Dalkey Island, north of Dublin have recently been confirmed through the finding of the species on a wreck (Mr. Tom Shakespeare, Irish Sub-Aqua Club, personal communication). The remaining Irish records are noted below and it will be seen that the species occurs all round the coast.

*British Records other than Channel Coast**West Wales :*

- Pembrokeshire : Musselwick, Castle Beach, Gunkel, Gateholm (Bassindale, 1957 : 250) ; Martin's Haven (Moyse, 1961).
 Skokholm : Crab and East Bays (Bassindale, 1957 : 250). Skomer : Mew Stone Basin, North Haven (Bassindale, 1957 : 250) ; sublittoral, off Skomer (Moyse, 1961 : 372).

Irish Sea (excluding Irish Coast) :

- Isle of Man : Calf Sound (Chadwick, 1903) ; (N. S. Jones, *in litt.*).

East Coast of Ireland :

- Larne : (Gosse, 1860 : 315).
 Belfast Lough : (Williams, 1954).
 Dublin Bay, off Dalkey Island : (Haddon, 1886 : 528) ; Stephens (1908 : 211) ; T. Shakespeare (*in litt.*).
 Wexford Bay : Gosse (1860 : 315).

S. Coast of Ireland :

- Youghal : Gosse (1860 : 315).
 Off Clonakilty Bay (10 miles S. of Galley Head Light : (Haddon, 1886 : 617).
 Lough Ine : Renouf (1931 : 426).

S.W. Ireland :

- Position $51^{\circ} 51' N.$, $10^{\circ} 31' W.$; Mouth of Kenmare River ; mouth of Bantry Bay ; Haddon (1886 : 617).
 Dingle Bay : Beaumont (1900 : 769).
 Bantry Bay : Gosse (1860 : 315).
 Valencia Harbour : Beaumont (1900 : 769).
 Manihine St. 1, $51^{\circ} 09' N.$, $11^{\circ} 01' W.$ 3rd July, 1950, trawl, 3 specimens.

West Coast of Ireland :

- Connemara ; Bundoran : Gosse (1860 : 315).

North Coast of Ireland :

- Lough Swilly ; Lough Foyle : Gosse (1860 : 315).
 Off Tory Island, 130 fms., July 12, 1935 (H. G. Stubbings *in litt.*).

Scotland :

- Millport, Isle of Cumbrae (numerous records).
 Oban : Coll. J. Alder (Johnston, 1847 : 198, pl. 35, fig. 4).
 Firth of Lorne, 30-50 fms. : Coll. John Murray (B.M. 1887.9.2.2).
 Loch Strivan, 20 fms. : Chumley (1918 : 48).
 Oronsay, low water : (Oundle School Natural History Society, *in litt.*).
 Moray Firth : Gosse (1860 : 315).
 Shetlands : off Foulah (Fleming, 1828 : 508) ; ? Shetland Haaf (Norman, 1868 : 319).

On the west coast of Scotland records are few (see above list) and probably reflect the little attention this coast has received. It is found off Cumbrae in the Firth of Clyde and there is an early record from the Moray Firth, as well as those of Fleming (1828) and of Norman (1868) from the Shetlands. Specimens from the dredgings

of the latter are in the British Museum (B.M. No. 1905.11.124-30). One of these is illustrated here (Pl. 12, fig. 4).

(d) *Scandinavian Distribution*

There are no records from Iceland but the species is found on the west coasts of Norway and Sweden as noted below :

Norway : Mandal, Risør, Krageør, Oslofjord, Hardangerfjord, Korsfjord, Hjeltefjord, Alvaerstrømmen (Carlgren, 1945 : 149).

Sweden : Bohuslan (various localities) ; Carlgren (1945 : 149) ; Gullmarfjord (Nilsson & Jägersten, 1961 : 49 and 53).

Records are absent for the Southern North Sea countries of Denmark, Germany, Netherlands and Belgium and for much of the East coast of England, there being, for example, no records for Cullercoats (Bull, 1939), Newcastle-upon-Tyne (Hobson, 1949) and Scarborough (Walsh & Rumington, 1953).

(e) *Distribution in Southern Europe and the Mediterranean*

Caryophyllia smithii is poorly recorded for the Atlantic coast of France and the Iberian peninsular. It has been recorded from Cezimbra, Portugal, by Saville Kent (1870 : 459), and at position 38° 16' 8" N., 8° 56' 43" W. by Rossi (1958 : 5). Most of the Mediterranean records are from the Western basin, but Rossi (1961 : 36) indicates that the species is found all over the Mediterranean in the "biocoenose coralligène" and Laborel & Vacelet (1958) state that it occurs in "microcavités au plafond des grottes sous-marines". Rossi (1957*a*, *b* ; 1961) gives the distribution of the species as Banyuls, Marseilles, Prom. di Portofino (Genoa), Naples and Malta ; she also records it from five *Calypto* stations in the general area 37° 10' N.-37° 50' N., 11° 02' 30" E.-12° 43' 15" E. from depths of 20-450 m. The same author (1957) believes the *C. smithii* is probably cosmopolitan in distribution, regarding *Caryophyllia alaskensis* Vaughan (1941 : 180, figs. 1-4) as identical with it ; this suggestion requires careful consideration.

3. THE DISTRIBUTION OF *PYRGOMA ANGLICUM* SOWERBY

It has already been noted that Hiro (1936) considered *Pyrgoma* to be almost an exclusively tropical genus and this suggested to me that our British species was probably at the limit of its northern range on our S.W. coasts.

In British waters *Pyrgoma anglicum* occurs exclusively on *Caryophyllia smithii* and according to Hiro (1936 : 45) both this genus and *Creusia* live always attached to or embedded in corals. In other words, they seem to be obligatory commensals. It was therefore thought desirable to ascertain as far as possible the limits of distribution of this barnacle in relation to its host in British waters. Fifteen species of *Pyrgoma* are known but only *P. anglicum* has been reported from British waters.

(a) *The Recorded Distribution in British Waters*

The British Museum contains some early material without locality labels some of which need not be mentioned here, but others are of historical interest and are included with some other records below.

BM. 1852.4.1.12. One *Caryophyllia smithii* with three large and one minute *Pyrgoma*; Stokes & Broderip (Torquay).

BM. 1855.12.27.22. Locality unknown. Six *Caryophyllia*, two specimens with one *Pyrgoma* each.

BM. 1899.5.24.1-4. Hincks Collection. Five *Caryophyllia*, one only with *Pyrgoma* (twelve large and numerous newly settled young).

BM. 1904.6.27.13. Eddystone. One *Caryophyllia* with *Pyrgoma* (Pl. 12, figs. 1-3). Coll. E. W. H. Holdsworth.

BM. 1905.11.1.7-15. Off the Dodman. Twenty-one specimens, all except seven with *Pyrgoma*. Coll. A. M. Norman.

The type locality of *Pyrgoma anglicum* is given as Devon (Sowerby, 1823, Pl. 3, fig. 7). By 1854, Darwin was able to generalize: "South coast England and of Ireland (12-45 fms., Forbes & MacAndrew)", as well as giving foreign records. However, I have been unable to trace genuine records for the south of Ireland and the distribution in the Channel is more restricted than Darwin would have us suppose.

Channel records as will be seen are confined to the western part. Specimens examined by Stokes & Broderip from Torquay carry *Pyrgoma* (B.M. 1852.4.1.12) and subsequently Holdsworth (quoted by Gosse, 1865: 282) found the barnacle in Plymouth Sound (B.M. 1904.6.27.13). Allen's survey of the Eddystone fishing grounds (1899) revealed the presence of *Caryophyllia* with *Pyrgoma* over a wide area between Eddystone and Prawle Point, while Norman & Scott (1906: 255) give additional localities off Polperro and quote W. P. Cocks as finding the species at Falmouth. An unpublished record in 1951, of the association of the two species at Tresco, Scilly Isles, has been kindly supplied by Mr. W. Fowler (B.M. 1960.8.4.1).

More recent records from the Plymouth area have been given by Forster (1958). *The Teignmouth, Dawlish and Torquay Guide* (Anon.) mentions that "beautiful clusters of this shell are found on a madreporo adhering to the rocks at low water at Torquay". . . The most easterly report of the species is that of Pilsbry (1916: 262) from Exmouth from the Gwyn Jeffreys collection in the Smithsonian Institution.

Offshore and extending well into the middle of the Channel from Plymouth, Crawshaw found *Pyrgoma* at a number of stations with *Caryophyllia* (see p. 409).

On the south side of the Channel, Lacaze Duthiers (1897) and Teissier (1950) summarize records from the Roscoff area and the former gives an excellent figure (1897, pl. 4, fig. E).

Reports of *Pyrgoma* are lacking from St. Malo and from the Channel Islands although the coral host has been taken at one locality near St. Malo and at all of the Channel Islands.

Apart from the unconfirmed statement by Darwin that *Pyrgoma* is found in Ireland, the records show that *Pyrgoma* is confined to the western Channel and Pembrokeshire, its known easterly distribution being Exmouth on the English side

and Roscoff on the south side. The possibility of the species being found at Ilfracombe and along the north coasts of Cornwall and Devon must now be considered. Gosse (1860 and 1865) is not precise about it; he studied both the Ilfracombe and the Torquay areas and his material in the British Museum dating from 1852 gives no clue. The carcinologist, T. R. R. Stebbing, possessed some material of *Caryophyllia* "bought at Ilfracombe" and this is now in the British Museum (B.M. 1927.9.11.1). There are two cemented stones, each with five *Caryophyllia* and the largest specimen bears a large *Pyrgoma*. It is by no means certain that the specimens were collected locally; in view of the fact that there must have been heavy demands for collectors' items during the years when P. H. Gosse held classes in marine zoology at Ilfracombe, it is possible that some supplies at least would be drawn from the Channel coast. Confirmation of the existence of *Pyrgoma* at Ilfracombe is likely as it is known from Pembrokeshire (Moyle, 1961).

(b) Wider Distribution

Darwin reported this species from Sicily, Madeira and the Cape Verde Islands (St. Jago). There are specimens on the coral *Cladocora debilis* Milne-Edwards & Haime, 1849, from Madeira (R. Boog Watson collection), this species being hitherto unreported as a host for this barnacle. Along the Biscay coast of France, it has been recorded from Cape Breton (Landes) and Biarritz by Fischer (1872) on *Dendrophyllia* and *Paracyathus*, while Broch (1927) found it on *Dendrophyllia cornigera* on the Moroccan coast. Pérès & Picard (1956) found *Pyrgoma* on *Leptopsammia pruvoti* in the Sicily-Tunis channel and Picard also recorded it on *Astroïdes calycularis* from Motril, S. Spain. Further afield it has been found at Singapore (Weltner, 1897) and Broch (1931: 119) mentions its occurrence off the Kei Islands on a fungiid coral. Hiro (1936) names *Psammocora* as its host in Tanabe Bay, Japan.¹

Hiro was inclined to think that species of *Pyrgoma* are, in general, largely restricted to one species of coral; this may be true for particular localities, but is not so for *P. anglicum*, which, in its wider distribution is now known from more than nine species of coral. So few workers have interested themselves in this association of barnacle and coral, that the list is likely to be extended considerably.

(c) Frequency and Numbers

The material available is not suitable for estimating the frequency with which *Pyrgoma* is found on *Caryophyllia*. Gosse, however, writing in 1865 (p. 282) states "so far as my experience goes, extending over a very extensive series of specimens, I think about one in six of these corals carries the parasite, generally situated either on, or just without the margin of the cup". This estimate agrees reasonably well with Crawshay's records of four positive stations (i.e., *Caryophyllia* with *Pyrgoma*) out of twenty-five stations at which *Caryophyllia* was taken, but the frequency probably varies greatly locally because gregariousness in settlement may ensure denser settlement in some places.

¹ For additional coral hosts see Addendum p. 415.

Gosse (1860 : 315) states that sometimes two *Pyrgoma* are found on the same coral, but a single *Caryophyllia* may carry a surprising number of barnacles. This author mentions in 1865 (p. 282) that he possessed specimens "one of which carries nine, the other eleven" and adds "Mr. Holdsworth mentions however that he had seen fourteen *Pyrgomata* attached to a single *Caryophyllia* dredged in Plymouth Sound".¹

One *Caryophyllia* of unknown locality, from the Cuming Collection, attached to a *Millepora*, carries twenty-four barnacles, and this heavy infestation bridges the gap across the disk of the corallite.

A series of nineteen *Caryophyllia* from off the Dodman Point, Cornwall, in the collection of the Rev. A. M. Norman, carried *Pyrgoma* in varying numbers as noted below :

- 1 with 14 *Pyrgoma*.
- 1 with 11 *Pyrgoma* (one on the flat base of the corallite).
- 1 with 9 *Pyrgoma*.
- 1 with 6 scars of *Pyrgoma*.
- 1 with 5 *Pyrgoma*.
- 3 with 4 *Pyrgoma*.
- 1 with 2 *Pyrgoma*.
- 3 with 1 *Pyrgoma* (two with one barnacle each and one with scar).
- 7 without *Pyrgoma*.

Another specimen from the Eddystone (B.M. 1904.6.27.13) bore nine large *Pyrgoma* and three minute ones on the larger barnacles.

On some *Caryophyllia*, notably a specimen from the Hincks collection and presumably Devon in origin, it is possible to recognize at least five settlement classes of *Pyrgoma* according to size and the manner of settlement. It is not however suggested that these are year classes as *Caryophyllia* is long lived and it is by no means improbable that settlement over a period up to twenty years or more may be represented.

Pyrgoma exhibits some gregariousness in settlement as later arrivals seem to exhibit preference for the hard surface of their own kind to that of the coral.

4. DISCUSSION

Caryophyllia smithii has been shown to have a wide distribution along the south-west and west coasts of Britain, extending round the Orkneys and Shetlands to the west coast of Norway and southwards to the deep-water fjords of the Bohuslan coast of Sweden. It appears to be absent along the east coast of England and in the countries bordering the southern N. Sea.

In the Eastern Channel records are wanting but this does not rule out the possibility of finding the specimens on hard substrata off shore.

The commensal barnacle has a much more restricted distribution in British waters, being confined to the western half of the Channel, and the Bristol Channel to Pembrokeshire ; this suggests that its distribution is limited by temperature as it is

¹This specimen (B.M. 1904.6.27.13) presented by Holdsworth to the British Museum actually carries ten large and medium *Pyrgoma* as well as seven young including scars ; it is illustrated on Pl. 12, figs 1-3).

for many other warm-water species which just reach this area. Surprisingly, on the south coasts of the Channel it has not been recorded further east than Roscoff, and, if it is truly absent from the Channel Islands, then it does not follow the expected pattern of distribution.

Pyrgoma anglicum is probably an obligatory commensal on corals of the genera *Caryophyllia*, *Dendrophyllia*, *Leptopsammia*, *Paracyathus*, *Astroides*, *Cladocora* and *Psammocora*.¹ Nothing is known of its relationship with the coral but it is reasonable to assume that heavy infestations must restrict the disk movements of the coral and possibly rob it of much of its food. It is noted too that the barnacles appear gregarious, preferring to settle on each other than on the column of the *Caryophyllia*.

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5. ADDENDUM

Since this paper was written, Dr. H. G. Stubbings has forwarded corals from the Atlantic coast of Africa for identification and on these *Pyrgoma* has been found on *Balanophyllia formosa* Gravier, 1915, and *Oculina* (*Schizoculina*) *fissipara* Milne Edwards & Haime, 1850, from the Ghana coast and on *Dendrophyllia cornigera* (Lamarck, 1816) taken in the Cape Verde Islands by the *Calyпсо*. Further details will be given in a forthcoming paper by Dr. Stubbings to whom I am much indebted for these records.

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¹ See Addendum p. 415.

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PLATE 12

FIGS. 1-3. Different views of *Caryophyllia smithii* with the commensal barnacle *Pyrgoma anglicum* from the Eddystone. Coll. E. W. H. Holdsworth (B.M. 1904.6.27.13).

FIG. 4. *Caryophyllia* from the Shetlands. Coll. A. M. Norman (B.M. 1905.11.1.24).

